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DESIGN AND IMPLEMANTATION OF A SMART WRISTBAND FOR ELDERLY PEOPLE IN REAL TIME ACCIDENTAL ALERT AT HOSPITAL AND RELATIVES USING GOOGLE MAP

by

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Department of Electrical and Electronic Engineering
INTERNATIONAL ISLAMIC UNIVERSITY CHITTAGONG

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A project
submitted as partial fulfilment of the requirement for the degree of

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

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MAY 2021

CERTIFICATE OF APPROVAL

The project entitled as "**Design and implementation of a smart wristband for elderly people in real time accidental alert at hospital and relatives using google map**" submitted by **Mohammad Ahsanul Islam**, bearing Matric ID. **ET 163024**, **MD. Mahadi Hasan Asif Mazumder**, bearing Matric ID. **ET 163029** of session **Autumn 2021**, to the Department of Electrical and Electronic Engineering (EEE), International Islamic University Chittagong (IIUC), has been accepted as satisfactory in partial fulfilment of the requirements for the degree of Bachelor of Science in Engineering and approved for the examination held on **28th May, 2021**.

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DECLARATION

It is hereby declared that this work has been done by us and no portion of the work contained in this project has been submitted elsewhere for the award of any degree or diploma.

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Mohammad Ahsanul Islam

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MD. Mahadi Hasan Asif Mazumder

ACKNOWLEDGMENT

In the name of Allah, the most gracious and the most merciful. First of all, we are grateful to almighty Allah for giving us strength and wisdom throughout all our life. We thank our family for their love, their moral and financial support they had given us. This helped us a lot. We would like to give our gratitude for our honorable supervisor Engr. Sk. Md. Golam Mostafa, Asst. Professor, Dept. of EEE, IIUC who has given us significant suggestions and inspections during the whole process of the work. His invaluable help of constructive comments and suggestions throughout the experiment and project work have contributed to the success of this project.

Last but not the least we are really grateful to our teachers, friends, classmates, seniors, juniors and lab Assistants, who have given us their unlimited support and help in each and every aspect. We are really fortunate to have nice human being like them beside us.

Authors

ABSTRACT

Healthcare technology is one of the most popular studies nowadays. With the development of healthcare technology, the lifespan of people has successfully extended. However, people elder in the remote area are still having a hard time to obtain professionals supervision due to the barrier of distance in a crucial time. A remote patient monitoring system is one of the best solutions to overcome this issue. This system proposes an Internet of Things (IoT) based real-time remote patient monitoring system that is able to monitor integrity of the real-time patients state and positioning data Message Queuing Telemetry Transport protocol is used for transmitting the real-time data from the proposed system to the server. The authority can access the webserver via smartphone to monitor the real-time recorded patient's data.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Falls are a major source of morbidity and mortality in older patients, representing 40% of all injury deaths. More than one third of people aged over 65 years old falls each year [1]. Fall incidence is even more serious considering that worldwide the population is aging. Falls are considered the main cause of fear and loss of independence among the elderly population. The occurrence of moderate to severe injuries contributes not only to the decrease of mobility and balance but also to psychological damages. These factors increase the risk of falling resulting in fall recurrence, it has been discovered that previous fallers have a probability of two thirds of falling again in the next year. The personal, social and economic effects of fall injuries make this an important global health concern. Reliable fall detection and emergency assistance notification are essential to provide adequate care and to increase the quality of life, especially among the elderly. The delay between the fall and the intervention has been found to be related with morbidity and mortality rates. Therefore, direct reporting to caregivers after fall detection can also improve medical care and reduce fall injuries.

1.2 Project Overview

We are going to design an automatic accident detection module using MEMS sensor. This system won't require any button to activate. It will be built in powerful algorithm that can detect the descend in the MEMS sensor. Here the continuation data stream of MEMS sensor will be observed closely alongside with the other sensor performance [2]. Whenever any changes are detected in the sensory part the algorithm will be able to detect the change. After detecting the fall, the system will be capable enough to send to phone call to hospital and the respective relatives for seeking help. We will GSM module to place call to the destination phone number automatically. We will use a suitable microprocessor to handle all the necessary operations. This method will be much more efficient and convenient enough to help any elderly people in time of danger. We are hoping that this system will be a milestone of elderly people's care.

1.3 Project Objective

i. To design a system that can detect the diastatic changes in value of MEMS sensor that will be mounted on elderly people's hand.

ii. To analyze the sensor data for effective decision making.

iii. Making the system capable enough to notify hospital and respective relative instantly about the danger.

1.4 Report Outline

Six chapters has covered in the course of design and development of this project. The chapters and their contents are as follows:

- Chapter 1 is the introductory chapter that gives the overview, motivation and objective of the project.
- Chapter 2 is literature review. Previous work related of this project has discussed in this chapter.
- Chapter 3 is hardware description. In this chapter, all the components used in this project has described elaborately.
- Chapter 4 deals with the system design of the project. In this chapter Block diagram, Circuit diagram, Flow chart and Programming of the project has discussed.
- Chapter 5 deals with the system implementation and results, Objective verification and system specification.
- Finally, the summary of this project has discussed in detail in chapter 6. The limitation of the project, advantage and future development has discussed on this topic.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Patient Monitoring System is a process in which a system can constantly supervise one person, in excess of one parameter at a time in a certain area. It helps in assessing the condition of patient's health system. Few works based on this system has portraited in this chapter.

2.2 Review of Previous Works

Few of the previous work based on patient monitoring has described below.

2.2.1 IoT Based Real-Time Remote Patient Monitoring System

The proposed patient monitoring system consists of four modules: a sensor, a main controller, a communication module and a webserver as shown in Figure 1 [3]. An ECG sensor AD8232 is used to collect the ECG data from the cardiac patient. It measures and amplifies the ECG signal based on the electrical activity of the heart muscle [4]. In the proposed system, Arduino ESP 32 which equipped with Wi-Fi is used as the main controller. The collected real-time ECG data will be processed by the main controller and then transmitted to the MQTT broker via Wi-Fi module. The ECG data is published to the webserver through Mosquito Message Queuing Telemetry Transport (MQTT) broker which is hosted by the Raspberry Pi 3. An MQTT-DB relay is applied in this work. It subscribes the same topic with the webserver in the MQTT broker, buffering the ECG SON data and then storing the ECG data in the database [5]. This allows the proposed system to display the real-time ECG signal on the webserver and stores it in a database simultaneously. Besides webserver, the doctor also can view the real-time ECG signal via Android mobile application (App). The App can display both heartbeat rate (BPM) and a real-time ECG chart. The BPM is extracted from the received real-time ECG data, it updates every 3 seconds. Doctors or nurses can access the database server to view the recorded history of ECG data. This work uses MQTT network protocol instead of Hypertext Transfer Protocol (HTTP) because MQTT requires low bandwidth, low power consumption and suitable for IoT development. The ECG signals data are packed into a SON Format string before sending it to the webserver and database. This greatly improves the efficiency of data converting at the client side because both webserver and database have a built-in function that can process the JSON format data. The webserver was implemented by using JavaScript programming language. The web sockets are used to display a real-time ECG signal based on the ECG JSON data that is transmitted from the proposed patient monitoring system. The webserver also performs package loss and jitter delay calculation. In order to test the performance of the proposed system in different environments, two experiments had been set up in real networking environments. The first experiment is set up in a private network or local area network (LAN). The proposed system, database system and computers as shown in Figure 1, are connected to the same access point. Assuming the patients in the hospital are equipped with the proposed system. The collected ECG data are stored in the in-house server. Doctors monitor their patients' real-time or previously recorded ECG data from their office. The second experiment is set up in the public network or Wide Area Network (WAN), as shown in Figure 2. Assuming the proposed system is connected to the home Wi-Fi [6]. The collected real-time ECG data is transmitted to the cloud server via internet. Doctors access the cloud server for observing the patient real-time ECG through their own mobile cellular network. The performance of the proposed system is measured based on the number of packet loss and average jitter delay. The real-time ECG signal was observed at Arduino Serial Monitor and webserver. The ECG signal displayed on the Arduino Serial Monitor is the real-time ECG signal collected by the AD8232 sensor. This ECG signal will be published by the MQTT broker to store in the database system and also display on the webserver. The experiment results show that there are no packet loss and packet errors in both private and public networks as shown in Table I and II, respectively. This is because MQTT protocol has a checksum function. It will resend the packet if subscribers failed to receive the packet.

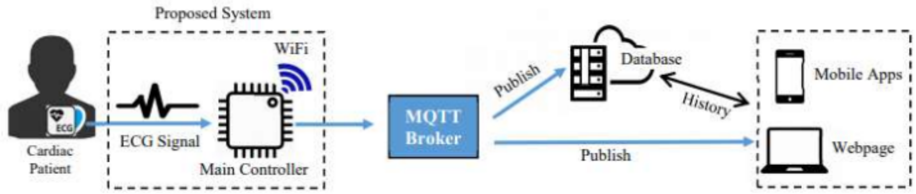

Fig. 2.1 IoT Based Real-Time Remote Patient Monitoring System [3]

5 However, this leads to delay in sending the next packet. 5 The developed real-time patient monitoring system has been tested in both private and public networks. The real-time ECG signal

was displayed on the web and storing in the cloud server successfully. The experiment results show that there are no package loss and package errors during transmission of ECG packages in both private and public networks. The proposed system can be applied in the hospital. The doctors or nurses can observe the ECG signal of any patients at any time and any place through the computer or smartphone, without going to the wards. This system is able to reduce the patients' traveling time and cost especially for those patients who are from suburban or rural areas. Doctors can monitor the ECG of the chronic cardiac patient in distance via the internet. The proposed system has the potential of improving the quality of healthcare services all over the nation. As future work, ECG self-interpretation algorithm can be implemented into the system so that the system can detect the abnormal ECG signal and generate an alert. This system also can be expanded by adding more e-health sensors to collect various health parameters. Research on reducing the jitter delay and eliminating the noise signal are also required to improve the performance of the proposed system.

2.2.2 Patient Monitoring System using Sensor Network Based on the ZigBee Radio

This technology is widely used in these days for internet connections. But this is not proper for sensor networking because of its bulky size and heavy power consumption [7]. So, we do not mention about this technology. This technology was developed to serve as a universal low-cost air interface for wireless office environment. It has relatively short range (l0cm to 10m) and its' data rate is up to 1Mbps in the 2.4-GHz band. Its' short range is no problem in u-Healthcare sensor network, but it has still heavy power consumption and software overload. Another limitation is its' network topology. Bluetooth has a basic network topology, 'piconet', which has only seven slave nodes. This is not proper for u-Healthcare network which will has several sensor nodes. We investigated the above technologies as the u Healthcare network implementation. Especially for the BAN (Body Area Network), we must carefully think about the physical network size and power consumption. Among the conventional technologies, the ZigBee is most efficient for the BAN. It consumes least power. But the physical size is some big. Tiny OS is another application of ZigBee. But BAN needs no relay features of Tiny OS that is it can be more compact. RFID is most compact and consumes least power. It may optimal for inner body sensors such as intracranial pressure sensor. For the case of networking several sensors on the human body, BTN (Body

Transmission Network) will be optimal solution. As a conclusion, we may consider each networking solution along the application and the type of sensor, the standardization problem. That is, we must make matching the sensor with the network technology by investigating many parameters which are physical size, data rate, power consumption, standard protocol, the level of technology, etc. This is a standard technology for home automation and slow rate data communication. It has dual physical band (2.4GHz and 868/915 MHz) and data rates of 250 kbps (2.4 GHz), 40 kbps (915 MHz), and 20 kbps (868 MHz). It was optimized for low data duty-cycle. In these days of u-Healthcare, for convenient monitoring of biological signals, the wireless communication technique is necessary. We have investigated several wireless technologies of biological sensor networking for u-Healthcare. There are some standard techniques such as Bluetooth, Wireless LAN, Zigbee etc. We have tested these techniques for biological sensor networking and summarize the advantages and the disadvantages. As a result, we decided the ZigBee radio as sensor network of patients in the hospital. We developed this patient monitoring system which has several biological parameters. Especially, this system has ability of patient's location awareness in the hospital.

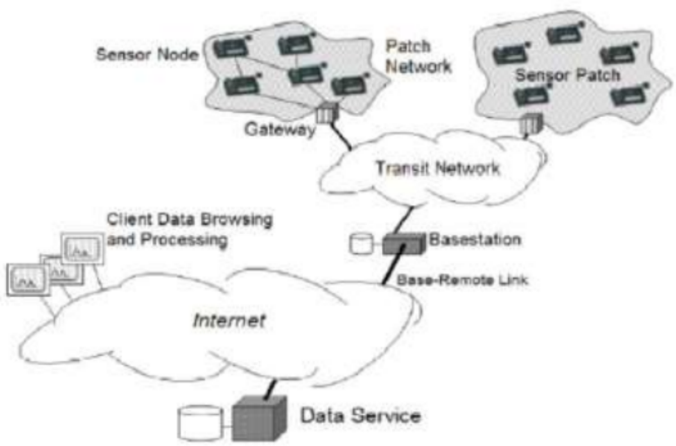

Fig. 2.2 Patient Monitoring System using Sensor Network Based on the ZigBee Radio [7]

2.2.3 Efficient Patient Monitoring for Multiple Patients Using WSN

The proposed system, as shown in figure, monitors the parameters of multiple patients such as their blood pressure, temperature, ECG, EEG [8]. These are processed and are compared with the threshold limits and are wirelessly transmitted to the patient monitoring system held at doctor's room. The data is also networked to the monitoring system in nurse room. Each patient is identified using their Unique ID and thus doctors will get a detailed report of each individual patient's current status and state. In case of doctor's absence, since the monitored data being stored at the nurse system, the monitored values along with their status can be send to the doctor's mobile phones [6] or make use of internet facility. Thus, system helps in the simultaneous monitoring of the multiple parameters in multiple patients. The various sensors used are blood pressure sensor, temperature sensor, SPO2 (pulse oximeter), ECG and EEG sensor. In this paper, authors concentrate on the blood pressure monitoring of multiple patients.

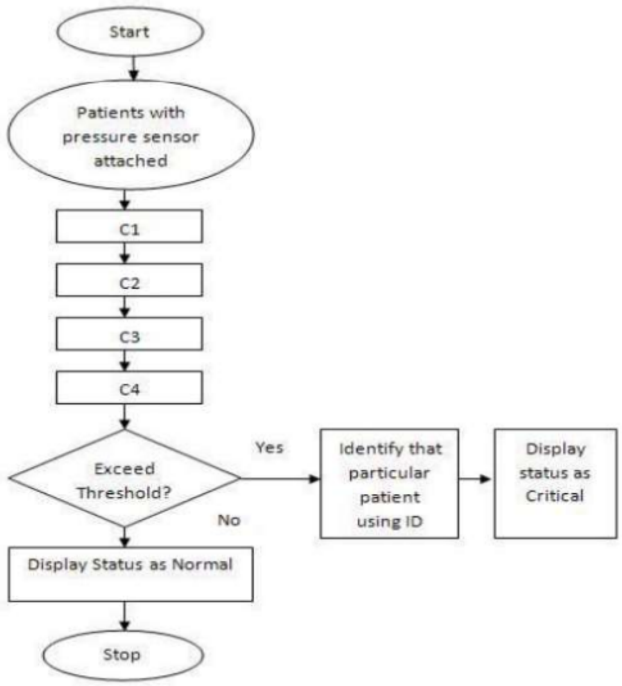

Fig. 2.3 Efficient Patient Monitoring For Multiple Patients Using WSN [8]

A decision-making algorithm shown in "Fig.2" is proposed based on the risk factor of patients. The risk factor can be obtained from the current status of patient. In the case of critical patient, the system can collect data continuously whereas in the case of patients with a low risk factor, an option of transmitting data after some duration of time is provided. Thus, power usage can be reduced. The parameter, authors focus on in this paper, is blood pressure. A monitored patient's condition can be classified into three blood pressure values: Normal, Mild Hypertension and

Severe Hypertension. Normal person's blood pressure ranges between 80 and 120. A person whose blood pressure value is between 120 and 140 is referred as having Mild Hypertension. A person whose blood pressure value lies above 140 is referred as having Severe Hypertension. By observing the monitored results authors can classify the patients into safe or critical zones and alert the doctor/nurse to come to the patient's aid if necessary. A reliable patient monitoring system that can monitor multiple patients' parameters simultaneously in an indoor scenario is proposed. The parameter taken for experimentation is blood pressure. Blood pressure readings from multiple patients are wirelessly transmitted to a central monitoring system using ZigBee technology. At the server each patient is identified using the Unique ID and thus doctors will get a detailed report of patient's current status and state. The health statuses of patients, with a high-risk factor, are monitored using biomedical sensor networks. Therefore, the performance of these networks is of the utmost importance as human lives are potentially threatened if the performance of this technology fails. The performance of the IEEE 802.15.4 standard in the network is analyzed in terms of packet delivery rate, propagation time, and transmission delay. The packet delivery rate increases when the data payload becomes large, but a large size packet suffers as it requires a larger transmission time.

CHAPTER 3

HARDWARE DESCRIPTION

3.1 Introduction

Hardware is the most important fact for a project. Choosing the necessary hardware is also very difficult. In this chapter, we are going to describe the hardware used for this project. We will also discuss the function of the chosen parts. By the end of this chapter, one will understand the reason behind choosing the used components and their function to this project.

3.2 List of Components

- ESP32 Microcontroller
- MPU6050 Accelerometer and Gyroscope
- Battery
- Neo 6m GPS Module
- A6 GSM Module

3.3 ESP32 Microcontroller

ESP32 is capable of functioning reliably in industrial environments, with an operating temperature ranging from –40°C to +125°C. Powered by advanced calibration circuitries, ESP32 can dynamically remove external circuit imperfections and adapt to changes in external conditions. Engineered for mobile devices, wearable electronics and IoT applications, ESP32 achieves ultra-low power consumption with a combination of several types of proprietary software [9]. ESP32 also includes state-of-the-art features, such as fine-grained clock gating, various power modes and dynamic power scaling. ESP32 is highly integrated with in-built antenna switches, RF balloon, power amplifier, low-noise receive amplifier, filters, and power management modules. ESP32 adds priceless functionality and versatility to your applications with minimal Printed Circuit Board (PCB) requirements. ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I^2C / UART interfaces.

Fig. 3.1 ESP 32 Dev Kit [9]

3.4 MPU 6050

A gyroscope is a device used primarily for navigation and measurement of angular. Gyroscopes are available that can measure rotational velocity in 1, 2, or 3 directions. 3-axis gyroscopes implemented with a 3-axis accelerometer to provide a full 6 Degree of Freedom (DoF) motion tracking system [10]. Gyroscopes have evolved from mechanical-inertial spinning devices consisting of rotors, axles, and gimbals to various incarnations of electronic and optical devices. Each exploits some physical property of the system allowing it to detect rotational velocity about some axis. The classic gyroscope exploits the law of conservation of angular momentum which, simply stated, says that the total angular momentum of a system is constant in both magnitude and direction if the resultant external torque acting upon the system is zero. These gyroscopes typically consist of a spinning disk or mass on an axle, which is mounted on a series of gimbals. Each gimbal offers the spinning disk an additional degree of rotational freedom. The gimbals allow the rotor to spin without applying any net external torque on the gyroscope. Thus, as long as the gyroscope is spinning, it will maintain a constant orientation. Vibrating structure gyroscopes are MEMS (Micro-machined Electro-Mechanical Systems) devices that are easily available commercially, affordable, and very small in size. Fundamental to an understanding of the operation of a vibrating structure gyroscope is an understanding of the Coriolis force. In a rotating system, every point rotates with the same rotational velocity. As one approaches the axis of rotation of the system, the rotational velocity remains the same, but the speed in the direction perpendicular to the axis of rotation decreases. Thus, in order to travel in a straight line towards or away from the axis of rotation while on a rotating system, lateral speed must be either increased or decreased in order to maintain the same relative angular position (longitude) on the body. The act of slowing down or speeding up is acceleration, and the Coriolis force is this acceleration times the mass of the object whose longitude is to be maintained. The Coriolis force is proportional to both the angular velocity of the rotating object and the velocity of the object moving towards or away from the axis of rotation.

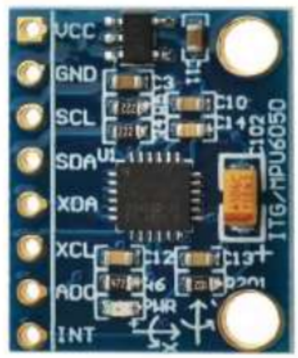

Fig. 3.2 MPU 6050 Gyroscope Module [10]

In this project we have used an MPU6050 based gyroscope module. MPU6050 sensor module is complete 6-axis Motion Tracking Device. It combines 3-axis Gyroscope, 3-axis Accelerometer and Digital Motion Processor all in small package. Also, it has additional feature of on-chip Temperature sensor. It has I^2C bus interface to communicate with the microcontrollers. It has Auxiliary I^2C bus to communicate with other sensor devices like 3-axis Magnetometer, Pressure sensor etc. If 3-axis Magnetometer is connected to auxiliary I^2C bus, then MPU6050 can provide complete 9-axis Motion Fusion output.

The MPU-6050 module has 8 pins, MPU6050 pin functions are below:

- INT: Interrupt digital output pin.
- AD0: I^2C Slave Address LSB pin. This is 0th bit in 7-bit slave address of device. If connected to VCC then it is read as logic one and slave address changes.
- XCL: Auxiliary Serial Clock pin. This pin is used to connect other I^2C interface enabled sensors SCL pin to MPU-6050.

- XDA: Auxiliary Serial Data pin. This pin is used to connect other I^2C interface enabled sensors SDA pin to MPU-6050.
- SCL: Serial Clock pin. Connect this pin to microcontrollers SCL pin.
- SDA: Serial Data pin. Connect this pin to microcontrollers SDA pin.
- GND: Ground pin. Connect this pin to ground connection.
- VCC: Power supply pin. Connect this pin to +5V DC supply.

3.5 Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices [11]. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver

Fig. 3.3 Power Bank for Power Supply [11]

energy to an external device. When a battery has connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery, which allows current to flow out of the battery to perform work. Batteries convert chemical energy directly to electrical energy. A battery consists of some number of voltaic cells. Each cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations . One half-cell includes electrolyte and the negative electrode, the electrode to which anions (negatively charged ions) migrate; the other half-cell includes electrolyte and the positive electrode to which cations (positively charged ions) migrate. Redox reactions power the battery. Cations are reduced (electrons are added) at the cathode during charging, while anions are oxidized (electrons are removed) at the anode during charging. During discharge, the process is reversed. The electrodes do not touch each other, but are electrically connected by the electrolyte. Some cells use different electrolytes for each half-cell. A separator allows ions to flow between half-cells, but prevents mixing of the electrolytes.

3.6 Neo 6m GPS Module

This is a complete GPS module that is based on the Ublox NEO-6M [12]. This unit uses the latest technology from Ublox to give the best possible positioning information and includes a larger built-in 25 x 25mm active GPS antenna with a UART TTL socket. A battery is also included so that you can obtain a GPS lock faster. This is an updated GPS module that can be used with ardupilot mega v2. This GPS module gives the best possible position information, allowing for better performance with your Ardupilot or other Multirotor control platform. The Ublox NEO-6M GPS engine on this board is a quite good one, with the high precision binary output. It has also high sensitivity for indoor applications. UBLOX NEO-6M GPS Module has a battery for power backup and EEPROM for storing configuration settings. The antenna is connected to the module through a ufl cable which allows for flexibility in mounting the GPS such that the antenna will always see the sky for best performance. This makes it powerful to use with cars and other mobile applications. The Ublox GPS module has serial TTL output, it has four pins: TX, RX, VCC, and GND. You can download the u-center software for configuring the GPS.

3.6.1 Features of Neo 6M GPS Module

- 5Hz position update rate
- Operating temperature range: -40 TO 85°CUART TTL socket
- EEPROM to save configuration settings
- Rechargeable battery for Backup
- The cold start time of 38 s and Hot start time of 1 s
- Supply voltage: 3.3 V
- Configurable from 4800 Baud to 115200 Baud rates. (default 9600)
- Indoor GPS: -162 dBm tracking sensitivity
- Support SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Separated 18X18mm GPS antenna

3.7 A6 GSM Module

A GSM modem is a wireless modem that works with a GSM wireless network [13]. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card from a

Fig. 3.4 A6 GSM Module [13]

wireless carrier in order to operate. GSM sim 300 Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications.

Applications like SMS Control, data transfer, remote control and logging can be developed easily. The modem can either be connected to PC serial port directly or to any microcontroller. It can be used to send and receive SMS or make/receive voice calls. It can also be used in GPRS mode to connect to internet and do many applications for data logging and control. In GPRS mode you can also connect to any remote FTP server and upload files for data logging. This GSM modem is a highly flexible plug and play quad band GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack. Computers use AT commands to control modems. Both GSM modems and dialup modems support a common set of standard AT commands. GSM modem can be used ust like a dial-up modem. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards.

CHAPTER 4

SYSTEM DESIGN

4.1 Introduction

This chapter includes system design and simulation of this project. Block diagram, Circuit diagram and Flowchart of the system has discussed below.

4.2 Block Diagram

The block diagram of the project has shown in **Fig. 4.1**. In this system, we have used a ESP32 to interface the necessary sensors and modules. Three-dimensional accelerometer sensor has used in this project alongside with having a gyroscope.

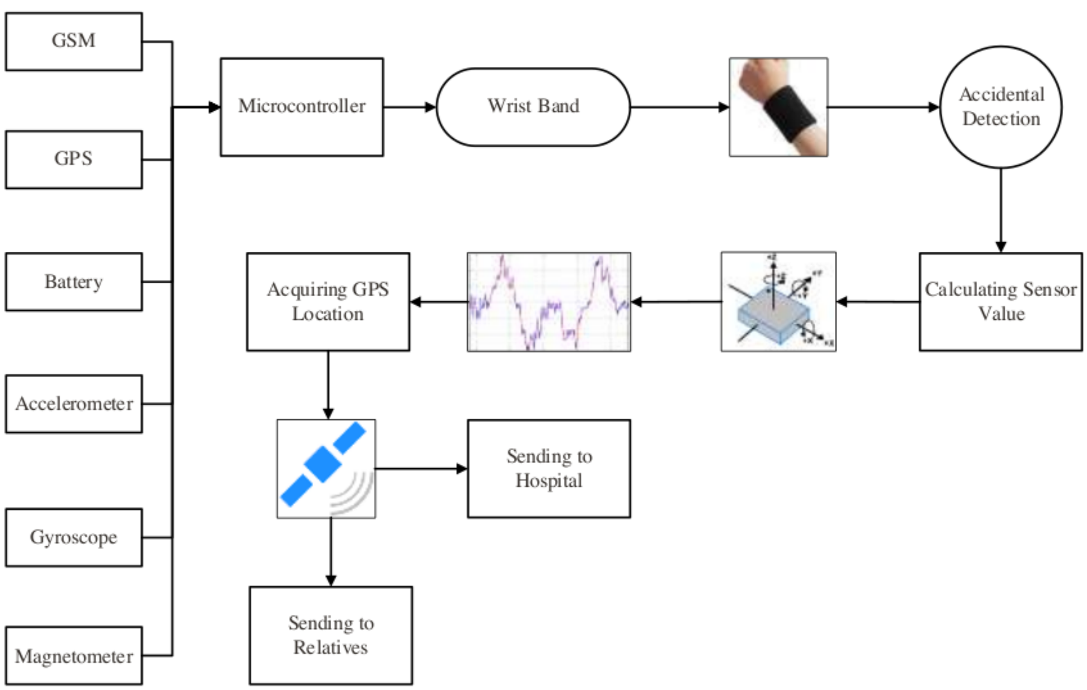

Fig. 4.1 Block Diagram of the System

The sensors have mounted on the wrist for detecting status of the user. When any anomaly is detected by the sensors the system will process the data of the occurrence. Then it will process an alert as output to the user via internet. These outputs alert a user who is monitoring or taking care of the patient.

4.3 Circuit Diagram

The circuit diagram of the system has shown in **Fig. 4.2**. Here a MPU6050 Sensors has used. The SCL of Sensor has connected with SCL and the SDA Sensor has connected with SDA of the microcontroller. The GSM and GPS sensor has connected using the UART ports as they transmit serial data to the ESP. All the systems are mounted with a portable jacket and powered by a power bank.

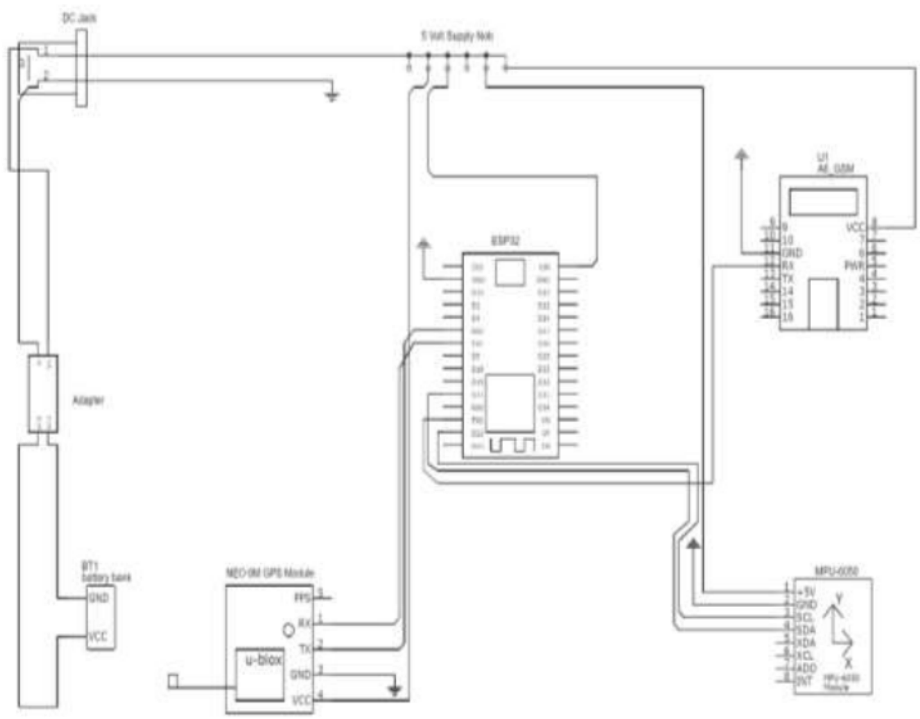

Fig. 4.2 Circuit Diagram of the System

In this circuit, we have used an ESP32, which has 39 I/O pins. We have used one Gyroscope here. This has used for accident detection purpose. To send notification to cell phone, we have used a Blynk IoT integration with our cellphone with the device. The Gyroscope sensor has also interfaced using the I2C protocol and connected the SCL and SDA of the microcontroller.

4.4 Programming

To program the system, we have used various library files and functions. These library files and functions has described below.

4.4.1 Library Files

- **wire.h:** This library allows communicating with I2C devices. Arduino communicate with I2C devices through the SDA (data line) and SCL (clock line) pin.
- **Serial Port:** The microcontroller hardware has built-in support for serial communication on pins 0 and 1 (which also goes to the computer via the USB connection). The native serial support happens via a piece of hardware (built into the chip) called a UART. This hardware allows the atmega chip to receive serial communication even while working on other tasks, as long as their room in the 64-byte serial buffer. The Software Serial library has been developed to allow serial communication on other digital pins of the Arduino, using software to replicate the functionality (hence the name ”Software Serial”). It is possible to have multiple software serial ports with speeds up to 115200 bps. A parameter enables inverted signaling for devices, which require that protocol.

4.4.2 Functions

- **void setup():** The void keyword is used only in function declaration. It returns no information to the function from it was called. The setup function initializes variables, pin modes, start using library etc. The setup function will only run once, after each power up.
- **void loop()** This function is used for running main program over and over again. This helps continuous execution of certain program simultaneously.
- **Serial.begin(9600):** Serial.begin(9600) doesn’t actually print anything. Rather it initializes the serial connection at 9600 bits per second. Both sides of the serial connection (i.e. the

Arduino and computer) need to be set to use the same speed serial connection in order to get any sort of intelligible data.

- **void read_mpu6050()** This user defined function allows to read accelerometer's data. This function first read three-dimensional data from accelerometer and then map the data to a desirable range.

4.5 Flow Chart

The flowchart of the whole system has shown in Fig. 4.3. This flow chart describes all the initialization and procedural of this project. At the beginning, the system will load necessary files. This will provide a basic understanding of the topic of our project. Then the system will wait for GPS power up. When the GPS will power up successfully, it will continue to the next step. Then it will search for GPS satellite. When it connects to satellite successfully, the system will allocate north and south coordinate on display successfully. At this position, the system is completely ready for detecting patient's mode.

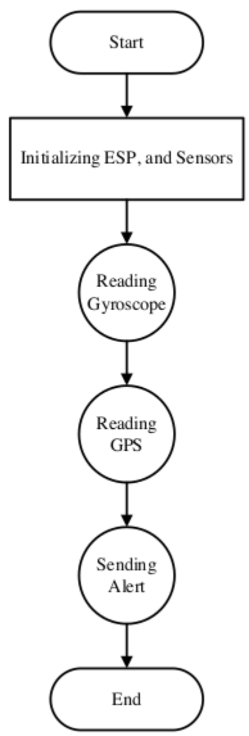

Fig. 4.3 Overall Flowchart of the System

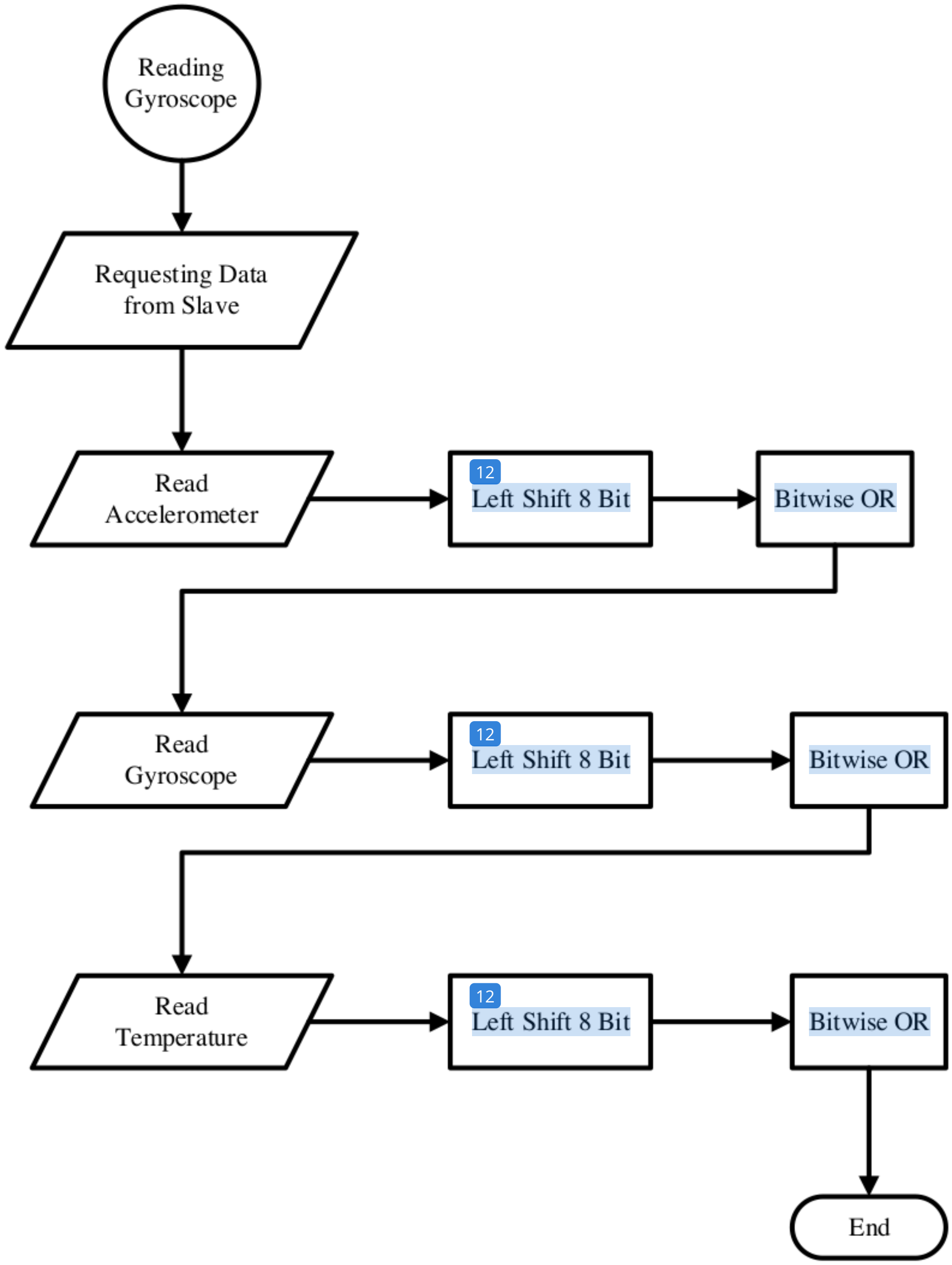

Fig. 4.4 MPU-6050 Operation

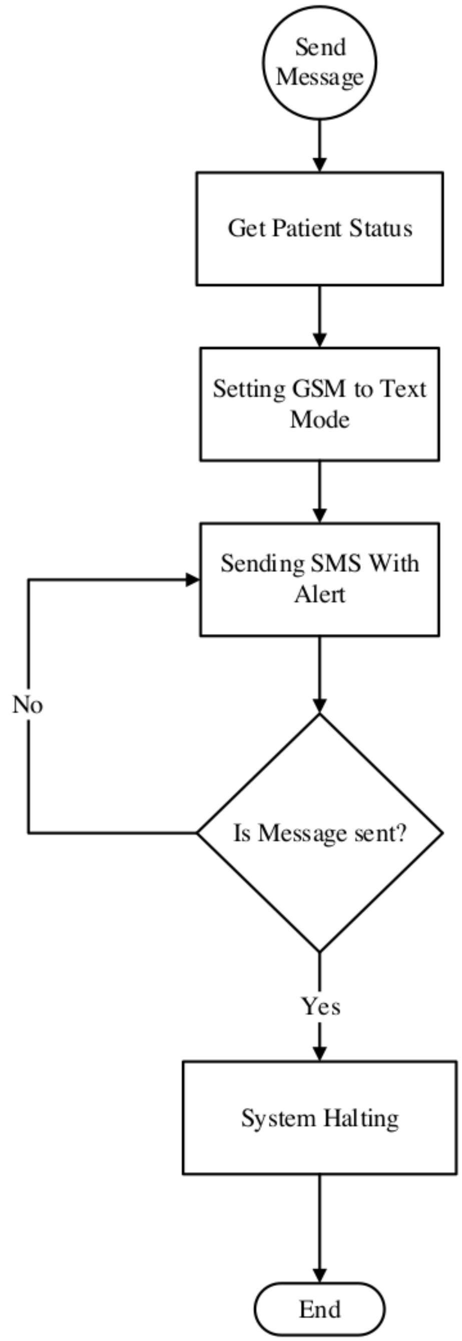

Fig. 4.5 GSM Module Operation

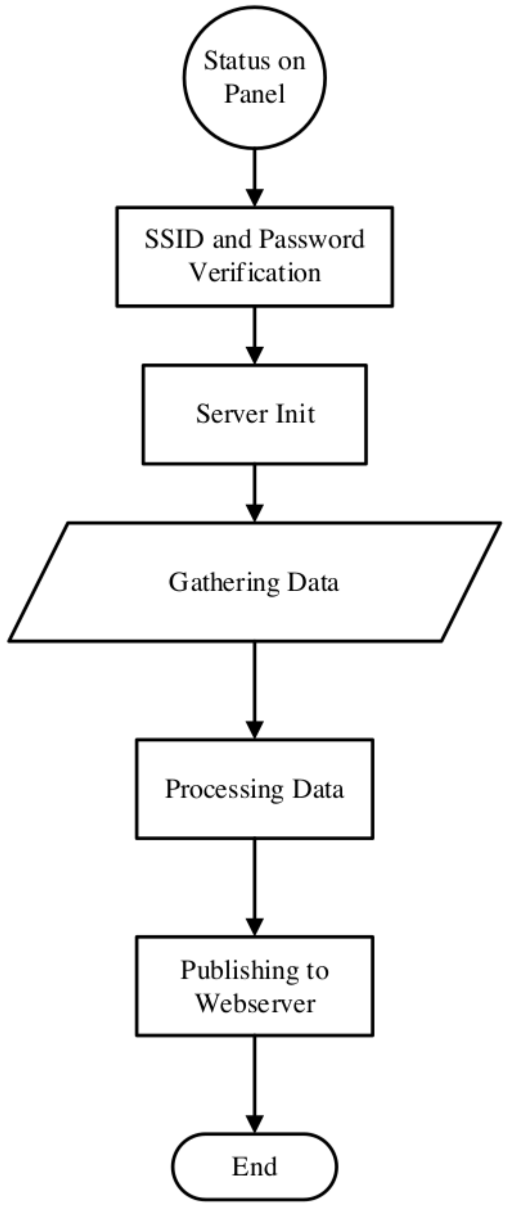

Fig. 4.6 IoT Panel Working Process

We have used a software visualization on Blynk for accident detection. When accident occurs, the system will save the system status, location, Gyroscope values within its memory and cautiously look over it. It will send the alert to the authority via the app. The MPU has connected with the I2C bus of the microcontroller. At first, the system reads the gyroscope sensor value. It measures the hand position in three-dimensional axis. We have predefined gyroscope value at certain points. At first, it will start communication on MPU address. Then it requests data from slaves. The device will get value from serial communication and left shift it eight bits and then performs bitwise or. In this procedure, it will follow this process to get all three-dimension value from serial communication. By using the coordinates value from the MPU, the device can understand patient condition.

CHAPTER 5

SYSTEM IMPLEMENTATION AND RESULT

5.1 Introduction

In this chapter, the complete implementation and objective justification have discussed with proper demonstration.

5.2 Project Overview

The complete project overview has shown in **Fig. 5.1**. In this system, we have designed a wearable device that can be mounted on patient's hand.

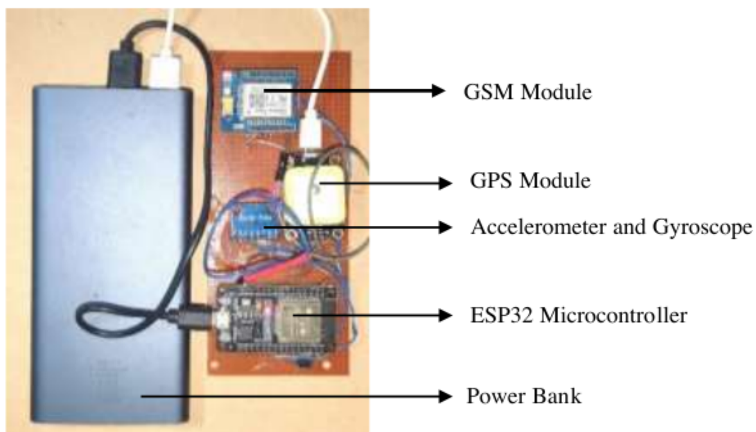

Fig. 5.1 Overview of the Project

This system contains a GSM module, GPS module, Accelerometer and Gyroscope sensor. All these systems are connected with internet of things by using an ESP32 module which can access internet via inbuild Wi-Fi chip. The whole system was powered by using a power bank that has USB interface.

5.3 Objective Justification

In this segment, we have showed all result that we have got from our project. The system has controlled using a IoT cloud application that checks for all the data from the device. The changes of data has analyzed below.

The overall IoT panel has shown in the Figure 5.2. Here we have the axes of Accelerometer Ax, Ay, Az on the first block of the application. After that the Gyroscope axes Gx, Gy, and Gz were placed for visualization.

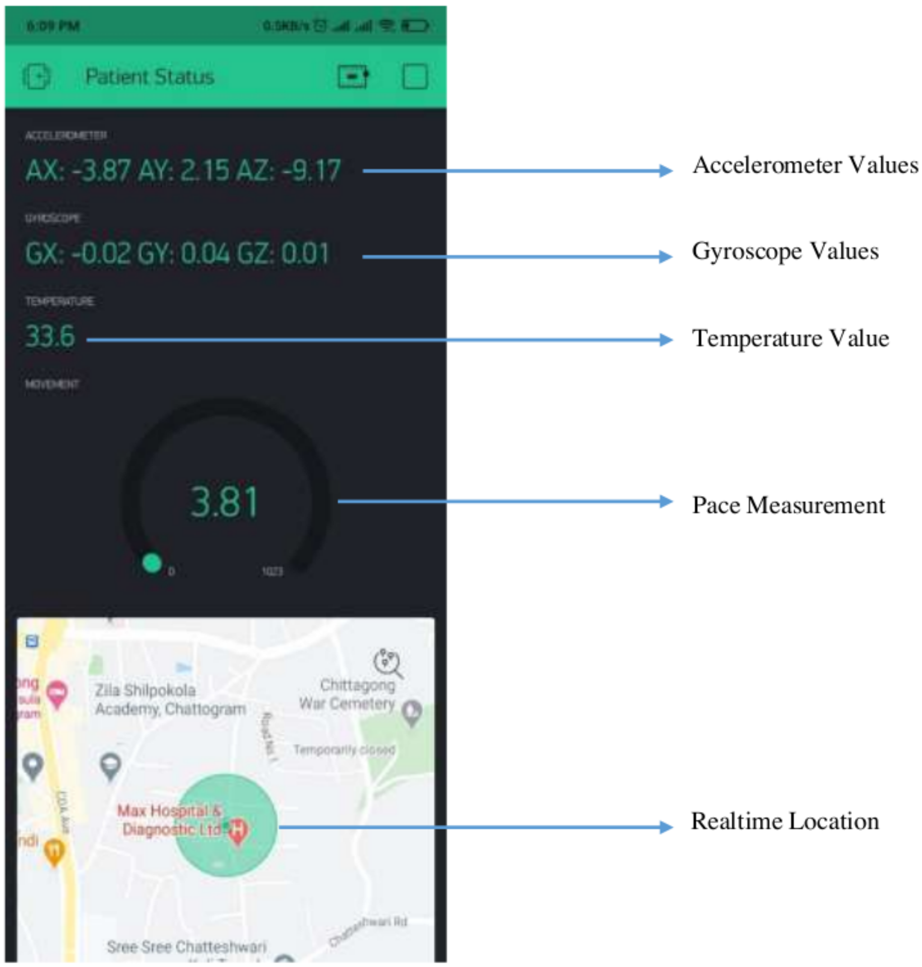

Fig. 5.2 The Overall IoT Panel of the Device

The temperature and the pace of the device has in the next blocks for the data broadcast. The map widget has on the next block. This map can access the GPS coordinate from the ESP32 and request the location by using the Google API.

The changes in Accelerometer, Gyroscope, and Movement has illustrated in the following figures.

Fig. 5.3 The Initial Data of Accelerometer, Gyroscope, and Movement Telemetry

Initially the values are at a default mode. Without any movement, the movement indicator is stable as shown in Figure 5.3.

Fig. 5.4 The Change of Accelerometer, Gyroscope, and Movement Telemetry

When the patient begin movement, the data begin to change as shown in Figure 5.4, 5.5, 5.6.

Fig. 5.5 The Change of Accelerometer, Gyroscope, and Movement Telemetry

Fig. 5.6 The Change of Accelerometer, Gyroscope, and Movement Telemetry

With the begin of movement the movement telemetry begins to change and the data will increase with the increase of patient's movement.

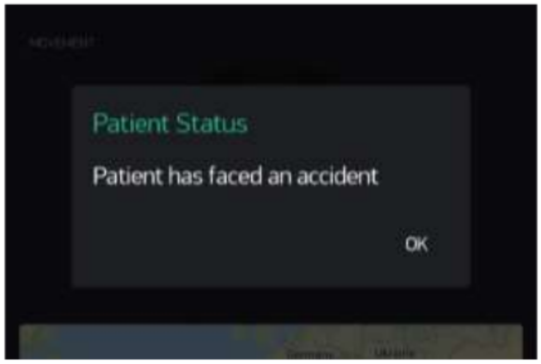

Fig. 5.7 Alert on IOT Panel When Accident is Detected

Whenever any accident is detected, it is reported on the IoT panel. The system will show that the patient has fallen. Immediately a call will be placed to seek for help. This system uses an active Wifi connection via ESP 32 module to access the application which is held in the Blynk server. The call is placed using the GSM module.

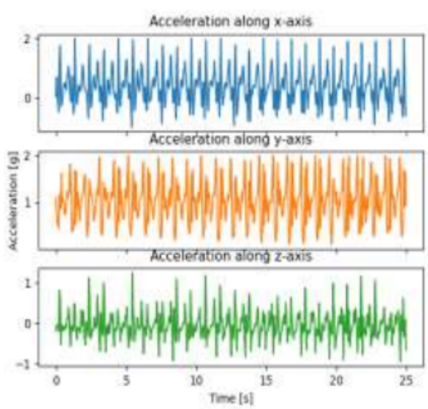

Fig. 5.8 Data From the MPU-6050

The data from the Accelerometer has plotted in the figure 5.8 which get updated with respect to the movement of patient.

The datapoints for three-dimensional accelerometer from starting point to accident detection procedural has drawn below.

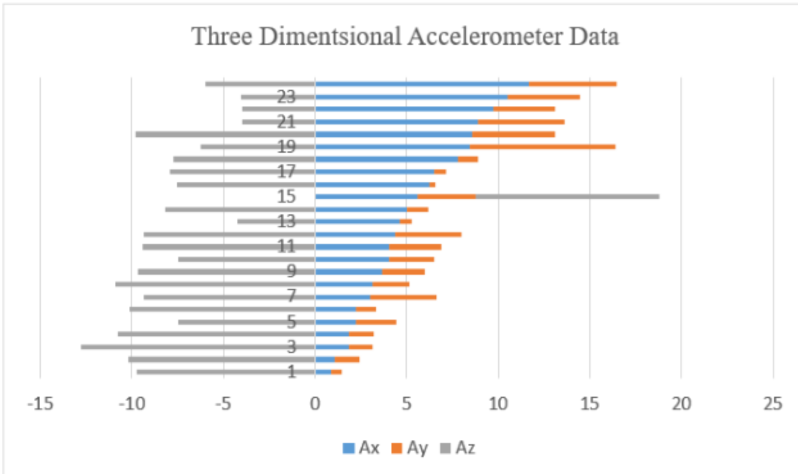

Fig 5.9 Three Dimensional Accelerometer Data

Up until the accident occurred, it was feasible to gather data by taking sensor readings at numerous locations throughout the hand positions. Then the data has drawn by using the graphical plotting toolbox to visualize the sensor data change at different positions.

CHAPTER 6

CONCLUSIONS

6.1 Conclusion

In this project, we designed and implemented a smart wrist band for elderly people in remote area. By this we can monitor the position of elder people in real time. This device will be mounted on elder people hand. This system is includes a GSM module, GPS module and MPU 6050 sensor. All this are connected with internet and an inbuilt wifi chip to an ESP32 module. The entire system was powered by a USB-interference power bank.

6.2 Application of this System

The application of this device has pointed below.

- This system can be used for tracking patients in real time and put the data on cloud.
- When an accidental is occurred, the device can alert the authority immediately which is very useful feature.

6.3 Limitation of Our Project

The limitation of this project has discussed below.

- The system isn't fully interpreted in a single PCB mount which sometimes cause connection issues of the connections.
- The device required an internet connection all the time.
- Sometimes false alarm is raised as the device is highly dependent on the MPU data.

6.4 Future Improvement

Some future work can be implemented later by further research has proposed below.

- We will improve the device hardware and outlook.

- Necessary programming improvement will be performed for removing false alarm completely.

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APPENDIX A

SOURCE CODE

```
/*
  pesic97636@bsmitao.com
  akash123456
  t_WAcsXy-Yzo3gqIBUN88f8ZoEQue-Ne
*/

#include <Adafruit_MPU6050.h>
#include <Adafruit_Sensor.h>
#include <Wire.h>
#include  <BlynkSimpleEsp32.h>
#define   BLYNK_PRINT Serial
#include  <WiFi.h>
#include "TinyGPS++.h"



char auth[] = "t_WAcsXy-Yzo3gqIBUN88f8ZoEQue-Ne"; // Auth Key from email
char ssid[] = "HAL9000"; //Wifi name
char pass[] = "asdfgqwertyqqq"; // Wifi pass

BlynkTimer timer;

WidgetMap blynk_map(V4);
unsigned int move_index = 1;       // fixed location for now

TinyGPSPlus gps;
```

```
Adafruit_MPU6050 mpu;

float ax, ay, az, gx, gy, gz, temp_val, lat_val, long_val;
String phone = "+8801815133266";


void setup(void) {
  Serial.begin(115200);
  Serial2.begin(115200); // to A6 module
  Wire.begin();

  Blynk.begin(auth, ssid, pass);

  Blynk.run();
  delay(100);


  mpu_setup();

  // String sms = "Device on";
  // send_message(sms);
  // call_number();


}


void loop() {
```

```
  mpu_values();

  Blynk.run();

  delay(1000);

  accident_alert();

}



void send_message(String sms_body) {

  Serial2.println("AT+CMGF=1");

  delay(200);

  Serial2.println("AT+CMGS=\"" + phone + "\"\r");

  delay(200);

  Serial2.print(sms_body);

  Serial2.println (char(26)); // ctrl-z

}


void call_number() {

  Serial2.println("ATD" + phone + ";");

 // delay(15000);

 // Serial2.println("ATH");



}



void mpu_values() {

  /* Get new sensor events with the readings */

  sensors_event_t a, g, temp;
```

```
mpu.getEvent(&a, &g, &temp);


/* Print out the values */
ax = a.acceleration.x;
ay = a.acceleration.y;
az = a.acceleration.z;
gx = g.gyro.x;
gy = g.gyro.y;
gz = g.gyro.z;
temp_val = temp.temperature;


Blynk.virtualWrite(V0, "AX: " + String(ax) + " AY: " + String(ay) + " AZ: " + String(az));
Blynk.virtualWrite(V1, "GX: " + String(gx) + " GY: " + String(gy) + " GZ: " + String(gz));
Blynk.virtualWrite(V2, temp_val);
Blynk.virtualWrite(V3, abs(gy * 102));



//
// Serial.print("Acceleration X: ");
// Serial.print(ax);
// Serial.print(", Y: ");
// Serial.print(ay);
// Serial.print(", Z: ");
// Serial.print(az);
// Serial.println(" m/s^2");
//
// Serial.print("Rotation X: ");
```

```
  // Serial.print(gx);
  // Serial.print(", Y: ");
  // Serial.print(gy);
  // Serial.print(", Z: ");
  // Serial.print(gz);
  // Serial.println(" rad/s");
  //
  // Serial.print("Temperature: ");
  // Serial.print(temp_val);
  // Serial.println(" degC");
  //
  // Serial.println("");
  delay(500);
}



void mpu_setup() {

  // Try to initialize!
  if (!mpu.begin()) {
    while (1) {
      delay(10);
    }
  }

  mpu.setAccelerometerRange(MPU6050_RANGE_8_G);
  switch (mpu.getAccelerometerRange()) {
    case MPU6050_RANGE_2_G:
```

```
    break;
  case MPU6050_RANGE_4_G:
    break;
  case MPU6050_RANGE_8_G:
    break;
  case MPU6050_RANGE_16_G:
    break;
  }
 mpu.setGyroRange(MPU6050_RANGE_500_DEG);
 switch (mpu.getGyroRange()) {
  case MPU6050_RANGE_250_DEG:
    break;
  case MPU6050_RANGE_500_DEG:
    break;
  case MPU6050_RANGE_1000_DEG:
    break;
  case MPU6050_RANGE_2000_DEG:
    break;
  }

 mpu.setFilterBandwidth(MPU6050_BAND_5_HZ);
 switch (mpu.getFilterBandwidth()) {
  case MPU6050_BAND_260_HZ:
    break;
  case MPU6050_BAND_184_HZ:
    break;
  case MPU6050_BAND_94_HZ:
    break;
```

```
    case MPU6050_BAND_44_HZ:
      break;
    case MPU6050_BAND_21_HZ:
      break;
    case MPU6050_BAND_10_HZ:
      break;
    case MPU6050_BAND_5_HZ:
      break;
    }

  delay(100);
}




void gps_location() {
  while (Serial.available()) {
    gps.encode(Serial.read());
  }

  if (gps.location.isUpdated()) {
    lat_val = gps.location.lat();
    long_val = gps.location.lng();

  }
}

void accident_alert() {
```

```
if (ax > 6 && az > -9) {

Blynk.notify("Patient has faced an accident");

Blynk.run();


//  String sms = "I'm in Danger!"

//

//  send_message(sms);


call_number();


}

}
```

Output

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